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EXAMINER

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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte LARRY D. KINSMAN and JERRY M. BROOKS

Appeal 2010-009613
Application 09/538,684
Technology Center 2800

Before, JOSEPH F. RUGGIERO, JOHN A. JEFFERY, and
BRIAN J. McNAMARA, *Administrative Patent Judges*.

McNAMARA, *Administrative Patent Judge*.

DECISION ON APPEAL

SUMMARY

Appellants appeal under 35 U.S.C. § 134(a) from the Examiner's non-final rejection of claims 1-4, 6, 8-12, 14-20, 22, 24-29, 31, 33-37, and 39-45. We have jurisdiction under 35 U.S. C. § 6(b). We affirm.

STATEMENT OF THE CASE

Appellants' invention concerns an integrated circuit (IC) package in which a heat sink is positioned at least partially within the package body. A surface of a first portion of the heat sink faces the lead frame in close proximity to a substantial part (e.g., at least 80 percent) of the enclosed portion of each of the leads of the lead frame to substantially reduce inductance associated with each of the leads. A die-attach area on the surface of the first portion of the heat sink supports the IC die. A second portion of the heat sink is connected to the first portion substantially opposite the die-attach area and projects away from the first portion and the IC die to dissipate heat from the IC die. (Spec. 5:10-20). Claim 1 is representative.

1. An integrated circuit package having a plurality of leads and a heat sink, the plurality of leads having reduced lead inductance comprising:

a package body;

an integrated circuit die positioned within the package body;

a lead frame including a plurality of leads having portions enclosed within the package body that connect to the integrated circuit die, the plurality of leads having portions enclosed within the package body forming an area; and

an electrically conductive heat sink positioned at least partially within the package body with a surface of a first portion of the heat sink facing the lead frame in close proximity to a substantial part of the enclosed portion of at least eighty percent of the area formed by the plurality of leads of the lead frame having portions enclosed within the package body and with a die-attach area on the surface of the first portion of the heat sink attached to the integrated circuit die, a

second portion of the heat sink under the die-attach area and the integrated circuit die projecting away from the first portion of the heat sink, the heat sink directly coupled to one of a signal voltage and a reference voltage, the heat sink operating respectively as a signal plane and a ground plane for the plurality of leads of the lead frame reducing lead inductance of the plurality of leads of the lead frame at least about 0.90 nanohenries [sic].

THE REJECTIONS

Claims 1-4, 6, 8, 11, 12, 14-16, 18-20, 24-29, 31, 33, 36, 37, and 39-45 stand rejected under 35 U.S.C. § 102(b) as being anticipated by US 4,994,936, issued Feb. 19, 1991 (Hernandez).

In the alternative, claims 1-4, 6, 8-12, 14-20, 22, 24-29, 31-37, and 39-45 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Hernandez as applied to claims 1-4, 6, 8, 11, 12, 14-16, 18-20, 24-29, 31, 33, 36, 37, and 39-45 *supra*.

Further in the alternative, claims 1-4, 6, 8, 11, 12, 14-16, 18-20, 24-29, 31, 33, 36, 37, and 39-45 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Hernandez as applied to claims 1-4, 6, 8, 11, 12, 14-16, 18-20, 24-29, 31, 33, 36, 37, and 39-45 *supra*, and further in combination with US 5,696,031, issued Dec. 9, 1997 (Wark).

Claims 9 and 10 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Hernandez as applied to claim 1, and further in combination with US 5,136,471, issued Aug. 4, 1992 (Inasaka).

In the alternative, claims 9 and 10 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Hernandez and Inasaka as applied to claims 9 and 10 *supra*, and further in combination with Wark.

Claim 17 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Hernandez as applied to claim 1, and further in combination with JP 05102338 A, published Apr. 23, 1993 (Nakamura).

In the alternative, claim 17 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Hernandez and Nakamura as applied to claim 17 *supra*, and further in combination with Wark.

Claim 22 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Hernandez as applied to claim 1, and further in combination with Wark.

Claims 34 and 35 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Hernandez as applied to claim 26, and further in combination with Inasaka.

In the alternative, claims 34 and 35 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Hernandez and Inasaka as applied to claim[s] 34 and 35 *supra*, and further in combination with Wark.

- I. THE REJECTION OF CLAIMS 1-4, 6, 8, 11, 12, 14-16, 18-20, 24-29, 31, 33, 36, 37, and 39-45 UNDER 35 U.S.C. § 102(b)

CONTENTIONS

The Examiner's anticipation findings are documented at pages 3-12 of the Examiner's Answer and are not repeated here.¹ With respect to claims 1-4, 6, 8,

¹ Throughout, we refer to the Appeal Brief filed on September 13, 2007, the Examiner's Answer mailed on January 9, 2008, the Reply Brief filed on March 4, 2008, Appellants' Substitute Argument filed on March 23, 2009, the Supplemental Appeal Brief filed on July 1, 2009, and the Supplemental Reply Brief also filed on July 1, 2009. The Appeal Brief filed on September 13, 2007, which is the basis for the Examiner's Answer, was defective and not ready for docketing (*See* Order dated February 19, 2009). We also note the Order dated March 10, 2010 correcting the Examiner's Statement of Rejection in the Examiner's Answer.

and 20 (and repeatedly with respect to the remaining claims), Appellants contend that Hernandez teaches a decoupling capacitor 34, 68 which cannot be the claimed electrically-conductive heat sink and a heat sink plug 60, located beneath an IC chip 28. (Supp. App. Br. 33). Appellants argue that one of ordinary skill would not consider the plain meaning of the word “heat sink” in the claimed invention to extend to the decoupling capacitor. (Supp. Reply Br. 5). Appellants further contend that the decoupling capacitor is attached to the heat sink and lead frame, but not the IC (*Id.*), at least with respect to the first embodiment in Hernandez (Supp. Reply Br. 7). The Examiner finds that Hernandez discloses the claimed structure in Figs. 16 and 21, that the claims are not limited to the die-attach area being directly attached to the IC die, and that Hernandez discloses at least an indirect attachment to the die. (Ans. 20-21).

Appellants also contend that the Examiner cites no authority for the proposition that the decoupling capacitor would reduce the lead inductance of the plurality of leads of the lead frame by 0.90 nanohenries or that such a characteristic is inherent to the decoupling capacitor taught by Hernandez. (Supp. App. Br. 34, Supp. Reply Br. 8). The Examiner’s response cites MPEP § 2112 and § 2113 for the proposition that once a reference teaches a substantially identical product, the burden shifts to the Applicants to come forward with evidence establishing an unobvious difference. (Ans. 21-22).

ISSUES

Did the Examiner err in applying the teaching in Hernandez of an integrated circuit structure including a decoupling capacitor with heat sink capabilities to the claimed heat sink?

Did the Examiner err in finding the claims could be anticipated in the absence of art specifically teaching the inductance to be reduced by at least 0.90 nanohenries based on structural similarities of the claimed invention and Hernandez?

ANALYSIS

Claims 1-4, 6, 8, and 20

Appellants group these claims together, with claim 1 being representative (Supp. App. Br. 33). As recited in claim 1, Appellants' invention is an integrated circuit package with a heat sink and reduced lead inductance. Appellants claim an IC package with reduced lead conductance having a heat sink that is electrically conductive, positioned within the package body and with two portions. The first portion faces the lead frame and is in close proximity to at least 80% of the area formed by the leads having portions enclosed within the package. This first portion also has a die-attach area on the surface of the first portion attached to the IC die. (*See* Claim 1, Supp. App. Br. 14-15).

The claimed heat sink also has a second portion under the die-attach area. The second portion projects away from the first portion. (*See* Claim 1, Supp. App. Br. 14-15).

The claimed heat sink is directly coupled to a signal voltage or a reference voltage, operates as signal plane or a ground plane for the leads of the lead frame, and reduces inductance of the plurality of leads by at least 0.90 nH. (*See* Claim 1, Supp. App. Br. 15).

Hernandez teaches an integrated circuit package that incorporates a decoupling capacitor, which is attached to the bottom of a die-attach area of the lead frame (i.e., die support platform 22). (Col. 5, ll. 2-5). The decoupling

capacitor in Hernandez is a flat parallel plate capacitor, preferably having a ceramic dielectric sandwiched between two conductive plates. The top conductor is attached to the IC lead frame and a lead from the bottom plate is attached to an appropriate finger of the lead frame. (Col. 2, ll. 26-39). Close proximity of the decoupling capacitor to the IC chip provides noise decoupling with very low inductance. (Col. 2, ll. 42-44).

Appellants' assertion that Hernandez does not contain any disclosure whatsoever as to how any capacitor may be modified into a "heat sink" having no thin flat plates and no ceramic dielectric (Supp. Reply Br. 5-6) is not persuasive. Nothing in Appellants' claims precludes either the heat sink from having such a structure or the heat sink from performing some other function, e.g., that of a decoupling capacitor, as disclosed in Hernandez. (Col. 4, ll. 16-19).

In addition, Hernandez teaches that the decoupling capacitor has heat sink capabilities and that enlarging the surface area of the capacitor both minimizes inductance in the leads from the lead frame and increases the capacitor's heat sink capabilities, with capacitor size being limited only by the distance between the dam bars, which support the lead frame. (Col. 4, ll. 16-19, col. 5, l. 42). Extending the capacitor surface area in this way would clearly occupy 80% of the area formed by the plurality of leads of the lead frame, as Appellants claim. In this embodiment of Hernandez heat from the IC is dissipated through the die bar, lead frame fingers and the decoupling capacitor itself. (Col. 5, ll. 6-13).

Appellants' argument that claim 1 is not anticipated because the decoupling capacitor is attached to the heat sink and lead frame rather than the IC (Supp. App. Br. 33), also fails. As the Examiner notes, claim 1 is not limited to a direct attachment. (Ans. 20-21). In their Supplemental Appeal Brief, Appellants map claim 1 to the embodiment in Fig. 1C (Supp. App. Br. 14-15, referring to die 74

and first part of heat sink 86). The description of Fig. 1C states that the die is attached through heat conductive material 82 to a die-attach area of the leads 76 and are in turn attached to a surface of a first portion 86 of the electrically conductive heat sink 88. (Spec. 13:15-19). Moreover, Hernandez teaches an embodiment in which the die support platform is removed and the IC is attached directly to a flat top 66 of the heat sink, which is then attached to the lead frame. (Col. 7, ll. 1-11). Thus, we conclude that the Examiner did not err in determining that Hernandez teaches the first portion of the heat sink attached to the integrated circuit die, as Appellants claim.

Hernandez also teaches an embodiment in which heat dissipation is enhanced with a heat sink plug extending outward from the die-attach location through the center of a modified decoupling capacitor. (Col. 6, l. 62- col. 7, l. 38, Figs. 16-21). The first and the second portions of Appellants' heat sink need not be integral and may be attached or interlocked parts (Spec. 10:5-7, 12:10-12), as taught by the decoupling capacitor and heat sink plug of Hernandez. Thus we conclude that the heat sink plug in Hernandez teaches the second portion of Appellants' claimed heat sink. (Fig. 16, Fig. 21).

Appellants contend that Hernandez does not teach the heat sink directly coupled to one of a signal voltage and reference voltage to act as a signal plane or a ground plane. However, Hernandez discloses the die support platform to which the capacitor is electrically connected (col. 5, ll. 3-4) is at ground (col. 5, ll. 14-16) and if not at ground, the decoupling capacitor is adhered to the die support platform by non-conductive adhesive. (Col. 5, ll. 23-26). Thus, this limitation of claim 1 is met by Hernandez.

Given the striking similarities between the structure taught by Hernandez and that of the claimed invention, we turn to Appellants' contentions concerning the functional limitation of reducing the lead inductance by 0.90 nH.

Appellants document the functional limitation of reducing the lead inductance by at least 0.90 nH with test results comparing the claimed IC package structure to conventional heat sinks where (i) the electrically conductive heat sink is electrically isolated (ii) the electrically conductive heat sink is connected to a signal voltage and (iii) the electrically conductive heat sink is grounded. (Spec. 11:9-18). Appellants do not explain how these specific amounts of inductance reductions are achieved, stating only that by extending the heat sink in close proximity to the leads 16, the first portion magnetically couples to the leads and reduces mutual and self-inductance of the leads. (Spec. 10:16-20, 12:20-23, and 14:8-11). Appellants' specification does not state whether the second portion of the heat sink magnetically couples to the leads. Appellants' specification also states that the distance of the heat sink from the leads, as well as the width of the heat sink, may be respectively decreased and increased to increase the effect of the heat sink in reducing the inductance associated with the leads. (Spec. 10:25-28, 13:1-4, and 14:16-20). Appellants' specification does not define "close proximity" or provide any dimensions concerning the distance of the heat sink from the leads or the width of the heat sink.

Informed by Appellants' disclosure, we conclude that the claimed reduction in inductance by at least 0.90 nanohenries, which is documented solely by the results of testing conducted on the claimed structure, is an inherent feature of the claimed structure. In addition, Appellants' disclosure that increasing the width of the heat sink increases the effect in reducing the inductance associated with the leads (Spec. 10:25-28, 13:1-4, and 14:16-20) is consistent with the specific

teaching in Hernandez that enlarging the surface area of the capacitor minimizes inductance in the leads from the lead frame. (Col. 5, ll. 34-36). In view of: (i) the similarities between the claimed structure and that taught by Hernandez, (ii) Appellants' description of the inductance reduction as being inherent in the structure and (iii) the consistency between Appellants' reported test results and the disclosure in Hernandez of the effect of enlarging the surface area of the capacitor, we conclude that the Examiner did not err in finding that, in the absence of contrary evidence presented by Appellants, the inductance reduction is inherent and that Hernandez anticipates claim 1 under 35 U.S.C. § 102(b). *See In re Fitzgerald*, 619 F.2d 67, 70 (CCPA 1980). We therefore sustain the rejection of claims 1-4, 6, 8, and 20 under 35 U.S.C. § 102(b).

Claim 24

Appellants separately argue the patentability of independent claim 24. Much of Appellants' argument concerning claim 24 repeats in detail Appellants' arguments concerning claim 1. (Supp. App. Br. 47-49). Independent claim 24 is drawn to an integrated circuit package with features similar to those of claim 1, but recites the electrically conductive heat sink as having a vertically extending columnar portion surrounded by a horizontally extending skirt portion, with the vertical portion being vertically thicker than the vertical thickness of the skirt. (*See* Claim 24). This structure is similar to the structure of the second heat sink portion and the first heat sink portion, respectively, recited in claim 1. Claim 24 also recites a lead frame attachment surface attached to the lead frame extending in close proximity to a substantial portion of the enclosed portions of at least 80 % of the area formed by the plurality of leads having portions enclosed by the package body proximate a die-attach surface substantially vertically aligned with the

columnar portion. (*See* Claim 24). The die-attach surface is attached to the IC, reducing lead inductance by at least about 0.90 nanohenries. This structure recited in claim 24 is similar to the structure recited in claim 1 in which the first portion of the heat sink facing the lead frame is in close proximity to a substantial portion of the area formed by the leads of the lead frame enclosed in the package body and has a die-attach area attached to the IC in which lead inductance is reduced by at least about 0.90 nanohenries. (*See* Claim 1). Claim 24 does not recite the limitations in claim 1 concerning coupling a signal or reference voltage to the heat sink.

In view of the similarities of the structures recited in claim 1 and claim 24, for the reasons discussed herein with respect to claim 1, we conclude that the Examiner did not err in finding claim 24 anticipated by Hernandez and we sustain the rejection under 35 U.S.C. § 102(b).

Claims 25-29, 31, 33, and 45

Appellants group these claims together and argue patentability of representative claim 25 by repeating many of the arguments Appellants made with respect to claim 1. (Supp. App. Br. 49-51). Independent claim 25 is drawn to an integrated circuit package. Claim 25 is similar to claim 1 except that claim 25 does not recite the limitations in claim 1 concerning a package body. In view of the similarities of the structures recited in claim 1 and claim 25, for the reasons discussed herein with respect to claim 1, we conclude that the Examiner did not err in finding claim 25 anticipated by Hernandez. We therefore sustain the rejection of claims 25-29, 31, 33, and 45 under 35 U.S.C. § 102(b).

Claims 11, 12, 36, and 37

Although Appellants argue patentability of these claims separately, because of the similarity of the claimed subject matter concerning the position of the heat sink and the similarity of the arguments advanced by Appellants, we group these claims together. Claim 11, which depends from claim 1 and claim 36, which depends from claim 26, both recite that the heat sink is positioned within the package body with the surface of its top portion in close proximity to substantially all of the enclosed portion of the plurality of leads of the lead frame. Claim 12, which depends from claim 1, and claim 37, which depends from claim 26, both recite that the heat sink is positioned within the package body with its first portion extending substantially to at least one side of the package body. In addition to repeating their other arguments, Appellants' primary argument concerning claims 11, 12, 36, and 37 is that the heat sink plug 60 in Hernandez is only under IC chip 28 and the decoupling capacitor extends under the lead frame. (Supp. App. Br. 36, 38, 53, and 55). We are not persuaded by Appellants' argument, because Hernandez discloses that the decoupling capacitor also has heat sink capabilities (col. 5, ll. 6-40), which are "further improved" by the addition of the heat sink plug. (Col. 6, ll. 62-65). Thus, we conclude that the Examiner did not err and we sustain the rejection of claims 11, 12, 36, and 37 under 35 U.S.C. § 102(b).

Claims 14 and 39

We group these claims together because of the similarity of the claimed subject matter. Claim 14, which depends from claim 1, and claim 39, which depends from claim 25, recite that the first and second portions of the heat sink are

integral with one another. Appellants argue that heat sink plug 60 and decoupling capacitor in Hernandez are separate parts. (Supp. App. Br. 40, 57). We agree that Hernandez does not disclose a heat sink with the first and second parts being integral with each other prior to assembly, although they form an integrated assembly when put together. Appellants' specification distinguishes heat sinks in which the first and second portions are integral with each other from those which comprise a plurality of attached or interlocked parts. (Spec. 10:4-8). Therefore, we conclude that Hernandez does not anticipate claims 14 and 39 under 35 U.S.C. § 102(b) and we reverse this rejection. However, as discussed further herein, because the parts form an integrated assembly, we also conclude that the structure recited in claims 14 and 39 is an obvious variation of Hernandez.

Claims 15, 16, 40, and 41

We treat these claims as a group because of the similarity of the claimed subject matter. Claim 15, which depends from claim 1, and claim 40, which depends from claim 25, recite that the first and second portions of the heat sink comprise separate parts. Claim 16, which depends from claim 1, and claim 41, which depends from claim 25, both recite that the heat sink comprises a plurality of parts, each forming a portion of the first and second portions. In addition to repeating their arguments concerning claims 1 and 25, Appellants argue that the heat sink plug 60 in Hernandez does not comprise separate parts. (Supp. App. Br. 42, 43, 59, and 61). We are not persuaded by Appellants' argument, because Hernandez discloses that the decoupling capacitor also has heat sink capabilities (col. 5, ll. 6-40), which are "further improved" by adding the heat sink plug. (Col. 6, ll. 62-65). As Appellants argued with respect to claims 14 and 39, the decoupling capacitor and heat sink plug are separate parts prior to assembly. Thus,

we conclude that the Examiner did not err and we sustain the rejection of claims 15, 16, 40, and 41 under 35 U.S.C. § 102(b).

Claims 18 and 43

Claim 18, which depends from claim 1, and claim 43, which depends from claim 25 both recite locking holes for locking the heat sink in the integrated circuit package. In addition to repeating their arguments with respect to claim 1, Appellants argue that the decoupling capacitor in Hernandez is not a heat sink, thus holes 74, 76, and 78 within the decoupling capacitor cannot comprise the claimed locking holes. (Supp. App. Br. 45, 64). However, as previously discussed, we are not persuaded by this line of reasoning because Hernandez teaches a decoupling capacitor with heat sink capabilities. Appellants also argue that even if the decoupling capacitor in Hernandez is a heat sink, holes 74, 76, and 78 allow the decoupling capacitor to attach to heat sink plug 60 and not the integrated circuit. *Id.* We note that the Examiner cites striations 64 and 84, as well as holes 74 and 78 of Hernandez in support of this rejection, but does not cite hole 76, which is not in contact with the surrounding molding compound. (Ans. 6). The claimed locking holes are shown in cross section in Fig. 1A at reference designator 17 and correspond at least to the striations 64 and 84 in Hernandez, which are provided to improve mechanical interlocking with the surrounding molding compound. (Col. 7, ll. 53-55). Thus, we conclude that the Examiner did not err and we sustain the rejection of claims 18 and 43 under 35 U.S.C. § 102(b).

Claims 19 and 44

Claim 19, which depends from claim 1, and claim 44, which depends from claim 25 both recite an adhesive attaching the lead frame to the heat sink.

Appellants repeat their arguments concerning claims 1 and 25 and, in addition, argue that the heat plug 60 in Hernandez attaches to the decoupling capacitor, which is not an electrically conductive heat sink, and not the lead frame. (Supp. App. Br. 47, 66). Hernandez teaches attaching the decoupling capacitor with heat sink capabilities to the die support platform of the lead frame with adhesive. (Col. 5, ll. 3-42). As discussed above, we are not persuaded by Appellants' argument, because Hernandez discloses that the decoupling capacitor also has heat sink capabilities (col. 5, ll. 6-40), which are "further improved" by adding the heat sink plug. (Col. 6, ll. 62-65). Thus, we conclude that the Examiner did not err and we sustain the rejection of claims 19 and 44 under 35 U.S.C. § 102(b).

Claim 42

Claim 42, which depends from claim 25 recites that the surface of the first portion of the heat sink includes a recess in which the die-attach area is located. Appellants repeat their arguments that claim 25 is unpatentable and, in addition, argue that the heat sink plug in Hernandez is depicted as a solid component without any recess therein. (Supp. App. Br. 62). As we have previously discussed, we are not persuaded by Appellants' argument, because Hernandez discloses that the decoupling capacitor also has heat sink capabilities (col. 5, ll. 6-40), which are "further improved" by adding the heat sink plug. (Col. 6, ll. 62-65). Turning to the claimed "recess" feature, we further note that the heat sink in Hernandez includes the lead frame, since heat dissipation of the IC silicon occurs through the die bar, lead frame fingers and the decoupling capacitor itself. (Col. 5, ll. 5-12, ll. 29-42). The lead frame has recessed die support platform 22, as Hernandez shows in Fig. 1. Hernandez teaches that the heat sink plug can be used without the flat top and attached to the die support platform. (Col. 7, ll. 15-17). Thus, we

conclude that the Examiner did not err in rejecting claim 42 as anticipated by Hernandez and we sustain the rejection of claim 42 under 35 U.S.C. § 102(b).

II. THE REJECTIONS OF CLAIMS 1-4, 6, 8, 11, 12, 14-16, 18-20, 24-29, 31, 33, 36, 37, and 39-45 UNDER 35 U.S.C. § 103(a)

Claims 1-4, 6, 8, 11, 12, 15, 16, 18-20, 24-29, 31, 33, 36, 37, and 40-45 over Hernandez

We sustained the Examiner's rejection of the above claims under 35 U.S.C. § 102(b). Therefore, the Examiner's rejection of these claims in the alternative under 35 U.S.C. § 103(a) as unpatentable over Hernandez is cumulative. We therefore sustain this rejection as well, for our previous reasoning also applies to this rejection. *See In re Kalm*, 378 F.2d 959, 962 (CCPA 1967) (noting that anticipation is the epitome of obviousness).

Claims 14 and 39 over Hernandez

Claim 14, which depends from claim 1, and claim 39, which depends from claim 25, recite that the first and second portions of the heat sink are integral with one another. In addition to their arguments concerning claim 1, which for the reasons discussed above, we have found not persuasive, Appellants contend that, even if the decoupling capacitor in Hernandez is part of the heat sink, they are separate parts and there is no motivation to modify Hernandez to include the limitations of claims 14 and 39. (Supp. App. Br. 81-82, 111-112). Hernandez teaches a decoupling capacitor with heat sink capabilities that are further improved with the addition of a heat sink plug in the form of a stem with a planar flat top affixed to the stem that attaches to an IC. (Col. 5, ll. 6-40, col. 6, ll. 62-col. 7, ll. 11). Hernandez discloses that the heat sink plug is positioned through aligned

openings in the decoupling capacitor. The decoupling capacitor and the heat sink are attached by means of adhesive. (Col. 7, ll. 30-34). These components form an integrated heat sink assembly. Hernandez thus teaches the desirability of forming a heat sink in which the first and second portions are integral with each other, as recited in claims 14 and 39. The result of forming a heat sink with the first and second parts integral to one another is predictable. “The combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results.” *Leapfrog Enters., Inc. v. Fisher-Price, Inc.*, 485 F.3d 1157, 1161 (Fed. Cir. 2007) (quoting *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 416 (2007)). Therefore, we sustain the Examiner’s rejection of claims 14 and 39 as unpatentable under 35 U.S.C. § 103(a) over Hernandez.

III. THE REJECTION OF CLAIMS 1-4, 6, 8, 11, 12, 14-16, 18-20, 24-29, 31, 33, 36, 37, AND 39-45 UNDER 35 U.S.C. § 103(a) OVER HERNANDEZ AND WARK

Having sustained the Examiner’s rejection of claims 1-4, 6, 8, 11, 12, 15, 16, 18-20, 24-29, 31, 33, 36, 37, and 40-45 under 36 U.S.C. § 102(b) as anticipated by Hernandez and claims 1-4, 6, 8, 11, 12, 14-16, 18-20, 24-29, 31, 33, 36, 37, and 39-45 under 35 U.S.C. § 103(a) as obvious over Hernandez, we turn to the rejection of the same claims as obvious over Hernandez and Wark. The Examiner finds that Wark teaches that the heat sink of Hernandez can be used in an integrated circuit with a processor. (Ans. 14). We find no error in the Examiner’s reasoning and we sustain the rejection of claims 1-4, 6, 8, 11, 12, 14-16, 18-20, 24-29, 31, 33, 36, 37, and 39-45 over Hernandez and Wark.

IV. THE REJECTION OF CLAIMS 9 AND 10 UNDER 35 U.S.C. § 103(a)
OVER HERNANDEZ IN VIEW OF INASAKA

The Examiner rejects claims 9 and 10 over the combination of Hernandez and Inasaka. (Ans. 15-16).

Claim 9, which depends from claim 1, recites the heat sink being coupled to a printed circuit board outside the package body thereby coupled to one of a signal and a reference voltage.

Claim 10, which depends from claim 8, recites that the second portion of the heat sink projects to one of a top and a bottom of the package body.

In rejecting these claims over Hernandez as applied to claim 1 in view of Inasaka, the Examiner finds that Inasaka, at column 2, lines 53-68 and column 4, lines 17-30, discloses the package body 30 coupled to a printed circuit board outside the package body thereby coupled to a signal voltage or a reference voltage. (Ans. 15, 18-19). In addition to repeating their arguments concerning Hernandez as applied to claims 1 and 25, Appellants argue that Inasaka cannot be combined with Hernandez because there is no motivation to modify the decoupling capacitor of Hernandez to include the claim limitations regarding the laminate wiring board of Inasaka or a reasonable expectation of success. (Supp. App. Br. 212, 221, 245, and 247).

We have already addressed Appellants' repetitious arguments concerning Hernandez. Hernandez discloses the die support platform to which the capacitor is electrically connected (col. 5, ll. 3-4) is at ground (col. 5, ll. 14-16) and if not at ground, the decoupling capacitor is adhered to the die support platform by non-conductive adhesive. (Col. 5, ll. 23-26). Thus, Hernandez teaches the heat sink coupled to one of a signal voltage and reference voltage, as recited in claim 9, so that the heat sink operates as a signal plane or a ground plane for the leads of the

lead frame. As noted by the Examiner, Inasaka stands for the unremarkable proposition that a multilayer printed circuit board can have layers, such as power layers, signal layers and ground layers (reference layers) that connect to integrated circuit pins. (Abstract, col. 2, ll. 21-26). Notwithstanding Appellants' arguments that there is no motivation to modify the decoupling capacitor of Hernandez to include limitations regarding the laminate wiring board (i.e., a multilayer printed circuit board) of Inasaka (Supp. App. Br. 212), we note that the claim is drawn to coupling the heat sink, such as that taught by Hernandez, to a printed circuit board without any limitation as to the type of board. Thus, we sustain the rejection of claim 9 under 35 U.S.C. § 103 as unpatentable over the combination of Hernandez and Inasaka.

Turning to claim 10, we note that Hernandez teaches orienting the second portion of the heat sink both toward the top and the bottom of the package, as evidenced by the comparison of at least Figures 21 and 22 and the text at column 7, lines 39-50. Thus, we sustain the rejections of claim 10 under 35 U.S.C. § 103(a) as unpatentable over the combination of Hernandez and Inasaka.

V. THE REJECTION OF CLAIMS 9 AND 10 UNDER 35 U.S.C. § 103(a)
OVER HERNANDEZ, INASAKA, AND WARK

The Examiner rejects claims 9 and 10 over the combination of Hernandez and Inasaka with Wark. As previously discussed herein, the Examiner finds that Wark teaches that the heat sink of Hernandez can be used in an integrated circuit with a processor. The rejection of claims 9 and 10 in further view of Wark is cumulative. We therefore sustain the rejection of claims 9 and 10 under 35 U.S.C. § 103(a) over Hernandez in combination with Inasaka and Wark.

VI. THE REJECTION OF CLAIMS 34 AND 35 UNDER 35 U.S.C. § 103(a)
OVER HERNANDEZ AND INASAKA

Claim 34 depends from claim 26 and recites the same limitations as claim 9, i.e., the heat sink being coupled to a printed circuit board outside the package body thereby coupled to one of a signal voltage and a reference voltage. Claim 34 includes the additional functional limitation that the heat sink operates respectively as a signal plane and a ground plane for the plurality of leads of the lead frame. For the same reasons as those discussed above with respect to claim 9, we sustain the rejection of claim 34 under 35 U.S.C. § 103(a) as unpatentable over the combination of Hernandez and Inasaka.

Claim 35 depends from claim 34 and recites the same limitation as claim 10 i.e., that the second portion of the heat sink projects to one of a top and a bottom of the package body. For the same reasons as those discussed above with respect to claims 9 and 10, we sustain the rejection of claim 35 under 35 U.S.C. § 103(a) as unpatentable over the combination of Hernandez and Inasaka .

VII. THE REJECTION OF CLAIMS 34 AND 35 UNDER 35 U.S.C. § 103(a)
OVER HERNANDEZ, INASAKA, AND WARK

The Examiner rejects claims 34 and 35 over the combination of Hernandez and Inasaka with Wark. (Ans. 19). As previously discussed, the Examiner finds that Wark teaches that the heat sink of Hernandez can be used in an integrated circuit with a processor. The rejection of claims 34 and 35 in further view of Wark is cumulative. We therefore sustain the rejection of claims 34 and 35 under 35 U.S.C. § 103(a) over Hernandez in combination with Inasaka and Wark.

VIII. THE REJECTION OF CLAIM 17 UNDER 35 U.S.C. § 103(a) OVER
HERNANDEZ AND NAKAMURA

Claim 17, which depends from claim 1, is rejected under 35 U.S.C. § 103(a) as unpatentable over Hernandez as applied to claim 1 in combination with Nakamura. The Examiner finds that Nakamura teaches the surface of the first portion of the heat sink including the recess in which the die-attach area is located (Ans. 16). Appellants argue that “The references themselves teach away from any proposed combination thereof since Nakamura teaches away from lead frames and encapsulating IC packages since doing so would prevent the reduced mounting height configuration wherein the circuit board has heat sink disposed within an opening therein.” (Supp. App. Br. 227). Appellants further argue “it would not be obvious to combine a method which involves disposing a heat sink attached to an IC chip in an opening in a circuit board (Nakamura) with a method of including a decoupling capacitor and heat sink plug in an IC package of Hernandez since to do so would destroy the invention of Hernandez. Even assuming the combination could be made, it would require that Hernandez exclude the lead frame. Further, no showing has been made of a likelihood of success that Hernandez could be modified by the teachings of Nakamura. As stated, Nakamura teaches away from incorporating a lead frame, heat sink and decoupling device in an encapsulated IC package since it would be render Nakamura ineffective for its stated objectives.” (Supp. App. Br. 227-228).

Claim 17, which depends from claim 1, recites the same additional limitation as that found in claim 42 which depends from claim 25 and which we concluded above is anticipated by Hernandez. Specifically, claim 17 recites that the first portion of the heat sink includes a recess in which the die-attach area is located. As we noted in our analysis of claim 42, the heat sink in Hernandez

includes the lead frame, since heat dissipation of the IC silicon occurs through the die bar, lead frame fingers and the decoupling capacitor itself. (Col. 5, ll. 5-12, ll. 29-42). The lead frame has recessed die support platform 22, as Hernandez shows in Fig. 1. Hernandez teaches that the heat sink plug can be used without the flat top and attached to the die support platform. (Col. 7, ll. 15-17). Thus, Hernandez teaches a heat sink with first and second portions having a recess in the first portion. The Examiner's findings concerning Nakamura demonstrate that it is known to insert a component, such as an integrated circuit, into a recess in a heat conducting apparatus, such as the printed circuit board in Nakamura. Thus, we conclude that the Examiner did not err in rejecting claim 17 as obvious over the combination of Hernandez and Nakamura.

IX. THE REJECTION OF CLAIM 17 UNDER 35 U.S.C. § 103(a) OVER HERNANDEZ, NAKAMURA, AND WARK

Alternatively, the Examiner rejects claim 17 as obvious over the combination of Hernandez, Nakamura and Wark. As previously discussed, the Examiner finds that Wark teaches that the heat sink of Hernandez can be used in an integrated circuit with a processor. The rejection of claim 17 in further view of Wark is cumulative. We therefore sustain the rejection of claim 17 under 35 U.S.C. § 103(a) over Hernandez in combination with Nakamura and Wark.

X. THE REJECTION OF CLAIM 22 UNDER 35 U.S.C. § 103(a) OVER HERNANDEZ AND WARK

Claim 22 is rejected over the combination of Hernandez and Wark. In the preamble, independent claim 22 recites an electronic system having an input device, output device, memory device and a processor device coupled to these

devices, with at least one of the devices having an integrated package with a plurality of leads and a heat sink with the plurality of leads having reduced lead inductance. The Examiner relies on Wark to teach the use of than IC with a heat sink in an electronic system. Much of Appellants' argument concerning claim 22 repeats in detail Appellants' arguments concerning claim 1. (Supp. App. Br. 236-241). The patentability of claim 22 turns on the limitations concerning the heat sink and reduced lead inductance. These limitations in claim 22 are almost identical to those of claim 1, except that claim 22 does not recite the limitations in claim 1 concerning coupling a signal voltage or reference voltage to the heat sink. In view of the similarities of the structure recited in claim 1 and claim 22, for the reasons discussed herein with respect to claim 1, we conclude that the Examiner did not err in finding claim 22 obvious over Hernandez and Wark and we sustain the rejection under 35 U.S.C. § 103(a).

CONCLUSION

We conclude that the Examiner did not err in applying the teaching in Hernandez of an integrated circuit structure including a decoupling capacitor with heat sink capabilities to the claimed heat sink.

We further conclude that the Examiner did not err in finding the claims could be anticipated in the absence of art specifically teaching the inductance to be reduced by at least 0.90 nanohenries based on the similarities of the claimed invention to the structure taught by Hernandez.

ORDER

The rejection of claims 1-4, 6, 8, 11, 12, 15, 16, 18-20, 24-29, 31, 33, 36, 37, and 40-45 under 35 U.S.C. § 102(b) as being anticipated by Hernandez is affirmed.

The rejection of claims 14 and 39 under 35 U.S.C. § 102(b) as being anticipated by Hernandez is reversed.

The rejection of claims 1-4, 6, 8-12, 14-20, 22, 24-29, 31-37, and 39-45 under 35 U.S.C. § 103(a) as being unpatentable over Hernandez is affirmed.

The rejection of claims 1-4, 6, 8, 11, 12, 14-16, 18-20, 24-29, 31, 33, 36, 37, and 39-45 under 35 U.S.C. § 103(a) as being unpatentable over Hernandez and Wark is affirmed.

The rejection of claims 9 and 10 under 35 U.S.C. § 103(a) as being unpatentable over Hernandez and Inasaka is affirmed.

The rejection of claims 9 and 10 under 35 U.S.C. § 103(a) as being unpatentable over Hernandez, Inasaka,, and Wark is affirmed.

The rejection of claim 17 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Hernandez and Nakamura is affirmed.

The rejection of claim 17 under 35 U.S.C. § 103(a) as being unpatentable over Hernandez, Nakamura,, and Wark is affirmed.

The rejection of claim 22 is under 35 U.S.C. § 103(a) as being unpatentable over Hernandez and Wark is affirmed.

The rejection of claims 34 and 35 under 35 U.S.C. § 103(a) as being unpatentable over Hernandez, and further in combination with Inasaka is affirmed.

The rejection of claims 34 and 35 under 35 U.S.C. § 103(a) as being unpatentable over Hernandez and Inasaka, and Wark is affirmed.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R § 1.136(a)(1)(iv).

AFFIRMED

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